

General

Guideline Title

Prophylaxis against venous thromboembolism in pediatric trauma: a practice management guideline from the Eastern Association for the Surgery of Trauma and the Pediatric Trauma Society.

Bibliographic Source(s)

Mahajerin A, Petty JK, Hanson SJ, Thompson AJ, O'Brien SH, Streck CJ, Petrillo TM, Faustino EV. Prophylaxis against venous thromboembolism in pediatric trauma: a practice management guideline from the Eastern Association for the Surgery of Trauma and the Pediatric Trauma Society. *J Trauma Acute Care Surg*. 2017 Mar;82(3):627-36. [36 references] [PubMed](#)

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Recommendations

Major Recommendations

The strength of recommendation (strong or weak/conditional) and levels of evidence (high, moderate, low or very low) are defined at the end of the "Major Recommendations" field.

Pharmacologic Prophylaxis in Children Hospitalized after Trauma (Population, Intervention, Comparator and Outcome [PICO] Question 1)

In children hospitalized after trauma (P), should pharmacologic venous thromboembolism (VTE) prophylaxis be utilized (I), compared with no pharmacologic prophylaxis (C), to reduce the incidence of VTE (O)?

Recommendation for Pharmacologic Prophylaxis in Children Hospitalized after Trauma (PICO Question 1)

The guideline authors conditionally recommend that pharmacologic prophylaxis be considered for children older than 15 years who are at low risk of bleeding. They also conditionally recommend that pharmacologic prophylaxis be considered for children younger than 15 years old who are post-pubertal if they have an Injury Severity Score (ISS) greater than 25. For prepubertal children, even with ISS greater than 25, the guideline authors conditionally recommend against routine pharmacologic prophylaxis. Further studies are necessary to provide recommendations in prepubertal children. These recommendations are conditional, given the paucity of published data in children and the very low quality of the available evidence. The recommendations are based on data in adults and the relative safety of enoxaparin at prophylactic doses in children (Gould et al., 2012; Bidlingmaier et al., 2011; Stem et al., 2013; Thompson et al., 2013).

Mechanical VTE Prophylaxis in Children Hospitalized after Trauma (PICO Question 2)

In children hospitalized after trauma (P), should mechanical VTE prophylaxis be utilized (I), compared with no prophylaxis or in addition to pharmacologic prophylaxis (C), to reduce the incidence of VTE (O)?

Recommendation for Mechanical Prophylaxis in Children Hospitalized after Trauma (PICO Question 2)

The guideline authors conditionally recommend that mechanical prophylaxis be considered alone or in addition to pharmacologic prophylaxis to hospitalized children older than 15 years and children younger than 15 years who are post-pubertal if they have an ISS greater than 25 for whom an appropriately sized device is available. This recommendation is conditional, given the paucity of published data in children and the very low quality of the available evidence. The recommendation is based on data in adults and the safety and tolerability of mechanical prophylaxis in children (Gould et al., 2012; Faustino et al., 2014).

Active Ultrasound Surveillance for VTE in Children Hospitalized after Trauma (PICO Question 3)

In children hospitalized after trauma (P), should active surveillance for VTE with ultrasound be performed (I), compared with daily physical examination alone (C), to detect VTE earlier (O)?

Recommendation for Active Ultrasound Surveillance for VTE in Children Hospitalized after Trauma (PICO Question 3)

The guideline authors conditionally recommend against active surveillance for VTE with ultrasound for earlier detection of VTE compared with routine daily physical examination alone in children hospitalized after trauma. The potential benefits of earlier detection and treatment of VTE are unclear, but the risk of bleeding with therapeutic anticoagulation is well documented.

Definitions

Grading of Recommendations Assessment, Development and Evaluation (GRADE) Methodology Levels for Rating the Quality of Evidence

Quality Level	Definitions
High	Very confident that the true effect lies close to estimate of effect
Moderate	Moderate effect; true effect is likely close to estimate of effect but may be substantially different
Low	Limited confidence; true effect may be substantially different from estimate of effect
Very Low	Little confidence; true effect likely substantially different from estimate of effect

GRADE Definition of Strong and Weak Recommendation

	Strong Recommendation	Weak/Conditional Recommendation
For patients	Most patients would want the recommended course of action.	Most patients would want the recommended course of action, but many would not.
For clinicians	Most patients should receive the recommended course of action.	Different choices will exist for different patients, and clinicians should help patients decide.
For policy makers	Recommended course should be adopted as policy.	Considerable debate and stakeholder involvement needed to make policy.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Venous thromboembolism (VTE) after hospitalization for pediatric trauma

Guideline Category

Management

Prevention

Risk Assessment

Treatment

Clinical Specialty

Critical Care

Emergency Medicine

Hematology

Pediatrics

Surgery

Intended Users

Advanced Practice Nurses

Nurses

Physician Assistants

Physicians

Guideline Objective(s)

- To evaluate whether pharmacologic or mechanical prophylaxis reduces the incidence of venous thromboembolism (VTE) in children hospitalized after trauma and whether active surveillance with ultrasound (versus daily physical examination alone) results in earlier detection of VTE in this population
- To evaluate putative risk factors for VTE in children hospitalized after trauma

Target Population

Children (0 to 21 years) hospitalized after trauma

Interventions and Practices Considered

1. Pharmacologic venous thromboembolism (VTE) prophylaxis (versus no pharmacologic prophylaxis)
2. Mechanical VTE prophylaxis (versus no prophylaxis or in addition to pharmacologic prophylaxis)
3. Active surveillance for VTE with ultrasound (versus surveillance with daily physical examination alone)
4. Assessment of risk factors for VTE

Major Outcomes Considered

- Incidence of venous thromboembolism (VTE)
- Time to detection of VTE

- Risk factors for VTE

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Inclusion Criteria for this Review

Study Types

The guideline authors included case series, cross-sectional studies, case-control studies, cohort studies, and randomized controlled trials. Original studies from meta-analyses and reviews were also included. Case reports, surveys, and letters to the editor were excluded.

Participant Type

Any patient 0 to 21 years old who developed venous thromboembolism (VTE) after being hospitalized for trauma was included. Similar children who did not develop VTE were included as control subjects.

Intervention Types

Pharmacologic VTE prophylaxis consisted primarily of low-molecular-weight heparin, particularly enoxaparin, unfractionated heparin, or warfarin. Mechanical prophylaxis consisted of pneumatic compression devices or compression stockings. Ultrasound scans of the lower extremities and of insertion sites for central venous catheters were used for active surveillance for VTE. The putative risk factors evaluated were age, severity of injury, presence of central venous catheters, major surgery, site and type of injury (i.e., acute spinal cord, pelvis fracture, femur fracture, head injury, abdominal injury, and chest injury), obesity, mechanical ventilation, use of recombinant factor VIIa, and immobilization.

Outcome Measure Type

The relevant outcomes were the incidence of VTE for Population, Intervention, Comparator, and Outcome (PICO) Questions 1 and 2 and time to detection of VTE for PICO Question 3. Via consensus, the writing group considered incidence of VTE as a critical outcome and time to detection of VTE an important outcome. Venous thromboembolism was defined as deep vein thrombosis in the extremities and/or pulmonary embolism. For PICO Questions 1 and 2, only symptomatic VTE was included because this was the most consistently reported outcome in pediatric studies. For PICO Question 3, VTE detected by active surveillance with ultrasound, regardless of symptoms, was compared with symptomatic VTE. The authors also used symptomatic VTE as outcome for the review of putative risk factors. Given the paucity of data, other relevant outcomes (e.g., duration of hospitalization, incidence of stroke, mortality rate, duration of anticoagulation, recurrence of VTE, incidence of post-thrombotic syndrome, and costs of care) were not evaluated, even though the writing group considered these as important outcomes.

Review Methods

Search Strategy

A medical librarian performed a systematic review of the MEDLINE database using PubMed from January 1946 to July 2015. The search strategies included "venous thromboembolism," "trauma," and "pediatric," with additional subject headings and text words per concept and with added specific terms for "prophylaxis" and "prevention." The search was restricted to humans, availability of full text article, and publication in English language. Only clinical studies in a pediatric trauma population, defined as 21 years or younger, or studies that combined adults and children but had delineated analyses for children were analyzed.

Study Selection

Abstracts were reviewed for relevance to the PICO questions of interest by one of the authors. Potentially relevant studies underwent full text review by the entire writing group to determine inclusion. Conflicts were resolved through group consensus.

Number of Source Documents

The literature search yielded 48 articles (see Figure 1 in the original guideline document). A total of 34 articles (71%) were excluded mainly because of study design. There were no randomized controlled trials. Of the included studies, only two addressed, at most partially, the Population, Intervention, Comparator, and Outcome (PICO) questions of interest. A total of 14 studies addressed the putative risk factors for venous thromboembolism (VTE).

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Grading of Recommendations Assessment, Development and Evaluation (GRADE) Methodology Levels for Rating the Quality of Evidence

Quality Level	Definitions
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Low	Limited confidence; true effect may be substantially different from estimate of effect.
Very Low	Little confidence; true effect likely substantially different from estimate of effect.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Data Extraction

Once the included articles were determined, data on the study type, subject characteristics, presence of putative risk factors for venous thromboembolism (VTE), type of prophylaxis, presence of VTE, and strength of association between exposure, that is, prophylaxis or putative risk factor, and VTE were extracted into a Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, Washington). Data were checked in duplicate for accuracy by two members of the writing group assigned to the Population, Intervention, Comparator, Outcome (PICO) question. Inconsistencies were resolved through full group review of the data and discussion.

Assessment of Methodological Quality/Grading of Recommendations Assessment, Development and Evaluation (GRADE) Process

The quality of evidence for each PICO question was assessed by two members of the writing group. Based on the GRADE guidelines, randomized controlled trials and observational studies were initially categorized as having high and low quality, respectively. The category was upgraded or downgraded based on the five core GRADE domains of risk for bias, inconsistency, indirectness, imprecision, and publication bias, as well as the size of effect. The quality of evidence for each study was finalized after discussions with the entire writing group. The guideline authors utilized GRADEpro (McMaster University and Evidence Prime Incorporated, Hamilton, Ontario, Canada), an online software, to create summary-of-findings tables for each PICO question.

Measures of Treatment Effect

Because of the small number of studies available for each PICO question and significant differences in study design, meta-analysis was not performed, and summary measures of treatment effect were not calculated. Incidence of VTE was presented as counts (%), whereas that for time to detection of VTE was presented as median days. Comparisons for incidence of VTE were performed using Fisher exact test. For the putative risk factors, significant heterogeneity of studies or lack of control subjects prevented calculation of summary measures of effect. Strengths of association were expressed as odds or risk ratios.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology provides guidance for rating evidence quality and grading strength of recommendations. Applying the GRADE methodology, a writing group from the Pediatric Trauma Society and the Practice Management Guidelines Section of the Eastern Association for the Surgery of Trauma developed recommendations with the goal of providing an evidence-based framework for hospitals that are developing local guidelines on venous thromboembolism (VTE) prophylaxis for children hospitalized after trauma.

The PICO (population [P], intervention [I], comparator [C], and outcome [O]) questions were as follows:

PICO Question 1

In children hospitalized after trauma (P), should pharmacologic VTE prophylaxis be utilized (I), compared with no pharmacologic prophylaxis (C), to reduce the incidence of VTE (O)?

PICO Question 2

In children hospitalized after trauma (P), should mechanical VTE prophylaxis be utilized (I), compared with no prophylaxis or in addition to pharmacologic prophylaxis (C), to reduce the incidence of VTE (O)?

PICO Question 3

In children hospitalized after trauma (P), should active surveillance for VTE with ultrasound be performed (I), compared with daily physical examination alone (C), to detect VTE earlier (O)?

Rating Scheme for the Strength of the Recommendations

Grading of Recommendations Assessment, Development and Evaluation (GRADE) Definition of Strong and Weak Recommendation

	Strong Recommendation	Weak/Conditional Recommendation
For patients	Most patients would want the recommended course of action.	Most patients would want the recommended course of action, but many would not.
For clinicians	Most patients should receive the recommended course of action.	Different choices will exist for different patients, and clinicians should help patients decide.
For policy makers	Recommended course should be adopted as policy.	Considerable debate and stakeholder involvement needed to make policy.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Not stated

Description of Method of Guideline Validation

Not applicable

Evidence Supporting the Recommendations

References Supporting the Recommendations

Bidlingmaier C, Kenet G, Kurnik K, Mathew P, Manner D, Mitchell L, Krampel A, Nowak-Göttl U. Safety and efficacy of low molecular weight heparins in children: a systematic review of the literature and meta-analysis of single-arm studies. *Semin Thromb Hemost*. 2011 Oct;37(7):814-25. [PubMed](#)

Faustino EV, Hanson S, Spinella PC, Tucci M, O'Brien SH, Nunez AR, Yung M, Truemper E, Qin L, Li S, Marohn K, Randolph AG, PROphylaxis against Thrombosis prACTice (PROTRACT) Study Investigators of the PALISI BloodNet. A multinational study of thromboprophylaxis practice in critically ill children. *Crit Care Med*. 2014 May;42(5):1232-40. [PubMed](#)

Gould MK, Garcia DA, Wren SM, Karanickolas PJ, Arcelus JI, Heit JA, Samama CM. Prevention of VTE in nonorthopedic surgical patients: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. *Chest*. 2012 Feb;141(2 Suppl):e227S-77S. [199 references] [PubMed](#)

Stem J, Christensen A, Davis D, Raffini L. Safety of prophylactic anticoagulation at a pediatric hospital. *J Pediatr Hematol Oncol*. 2013 Oct;35(7):e287-91. [PubMed](#)

Thompson AJ, McSwain SD, Webb SA, Stroud MA, Streck CJ. Venous thromboembolism prophylaxis in the pediatric trauma population. *J Pediatr Surg*. 2013 Jun;48(6):1413-21. [PubMed](#)

Type of Evidence Supporting the Recommendations

The type of evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- Given the rising incidence of venous thromboembolism (VTE) in children and the resultant morbidity and excess cost, there is growing impetus for hospitals to institute local pediatric guidelines on VTE prophylaxis, particularly in high-risk populations, such as those hospitalized after trauma.
- Inferred from two studies, the use of mechanical, versus no prophylaxis, suggested a possible reduction on the incidence of VTE. This effect is strengthened by data in adults showing significant reduction in the incidence of VTE after trauma with mechanical prophylaxis.

Refer to the "Qualitative Synthesis" and "Quantitative Synthesis (Meta-analysis)" sections of the original guideline document for discussion of evidence related to benefits of specific interventions.

Potential Harms

Earlier diagnosis of venous thromboembolism (VTE) with active ultrasound surveillance may lead to increased use of therapeutic anticoagulation without clear benefit. In adults, active surveillance for deep vein thrombosis (DVT) with ultrasounds was not efficacious in reducing the risk of symptomatic VTE. It may, in fact, increase the risk of bleeding with therapeutic anticoagulation for any detected asymptomatic DVT. The risk of major bleeding with therapeutic anticoagulation in children can be as high as 24% with unfractionated heparin and 4% with enoxaparin. In addition, the cost of widespread active surveillance with ultrasound for these uncommon events would need to be considered before general utilization could

be recommended.

Refer to the "Qualitative Synthesis" and "Quantitative Synthesis (Meta-analysis)" sections of the original guideline document for discussion of evidence related to harms of specific interventions.

Qualifying Statements

Qualifying Statements

- The Eastern Association for the Surgery of Trauma (EAST) is a multi-disciplinary professional society committed to improving the care of injured patients. The Ad Hoc Committee for Practice Management Guideline Development of EAST develops and disseminates evidence-based information to increase the scientific knowledge needed to enhance patient and clinical decision-making, improve health care quality, and promote efficiency in the organization of public and private systems of health care delivery. Unless specifically stated otherwise, the opinions expressed and statements made in this publication reflect the authors' personal observations and do not imply endorsement by nor official policy of EAST.
- "Clinical practice guidelines are systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances."* These guidelines are not fixed protocols that must be followed, but are intended for health care professionals and providers to consider. While they identify and describe generally recommended courses of intervention, they are not presented as a substitute for the advice of a physician or other knowledgeable health care professional or provider. Individual patients may require different treatments from those specified in a given guideline. Guidelines are not entirely inclusive or exclusive of all methods of reasonable care that can obtain/produce the same results. While guidelines can be written that take into account variations in clinical settings, resources, or common patient characteristics, they cannot address the unique needs of each patient nor the combination of resources available to a particular community or health care professional or provider. Deviations from clinical practice guidelines may be justified by individual circumstances. Thus, guidelines must be applied based on individual patient needs using professional judgment.
- These guidelines represent a detailed summary of the limited literature regarding venous thromboembolism (VTE) prophylaxis in children hospitalized after trauma. The available evidence is of very low quality and observational in nature. As such, evidence from adults was considered in the writing group's recommendations. These guidelines are intended to inform the decision-making process rather than replace clinical judgment.

*Institute of Medicine. Clinical practice guidelines: directions for a new program. MJ Field and KN Lohr (eds) Washington, DC: National Academy Press. 1990: pg 39.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Staying Healthy

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Mahajerin A, Petty JK, Hanson SJ, Thompson AJ, O'Brien SH, Streck CJ, Petrillo TM, Faustino EV. Prophylaxis against venous thromboembolism in pediatric trauma: a practice management guideline from the Eastern Association for the Surgery of Trauma and the Pediatric Trauma Society. *J Trauma Acute Care Surg*. 2017 Mar;82(3):627-36. [36 references] [PubMed](#)

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2017 Mar

Guideline Developer(s)

Eastern Association for the Surgery of Trauma - Professional Association

Pediatric Trauma Society - Professional Association

Source(s) of Funding

Eastern Association for the Surgery of Trauma (EAST)

Guideline Committee

A writing group from the Pediatric Trauma Society and the Practice Management Guidelines Section of the Eastern Association for the Surgery of Trauma

Composition of Group That Authored the Guideline

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Financial Disclosures/Conflicts of Interest

S.J.H. is a site investigator for an anticoagulation trial sponsored by Bristol-Myers Squibb. S.H.O. is the principal investigator and a steering

committee member for anticoagulation trials sponsored by Bristol-Myers Squibb and Pfizer. S.H.O. is also a member of the data and safety monitoring board for GlaxoSmithKline. E.V.S.F. is a member of the data and safety monitoring board for an anticoagulation trial sponsored by GlaxoSmithKline and is partially supported by a grant from the American Heart Association.

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Available from the [Journal of Trauma and Acute Care Surgery Web site](#) .

Availability of Companion Documents

The following is available:

- Kerwin AJ, Haut ER, Burns JB, Como JJ, Haider A, Stassen N, Dahm P, Eastern Association for the Surgery of Trauma Practice Management Guidelines Ad Hoc Committee. The Eastern Association of the Surgery of Trauma approach to practice management guideline development using Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology. J Trauma Acute Care Surg. 2012 Nov;73(5 Suppl 4):S283-7. Available from the [Eastern Association for the Surgery of Trauma \(EAST\) Web site](#) .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on May 9, 2017. The information was verified by the guideline developer on May 31, 2017.

Copyright Statement

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